

REMARKS

In the last Office Action, the Examiner rejected claims 1-10 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,660,344 to Lub.

In accordance with the present response, the specification has been suitably revised to correct informalities and bring it into better conformance with U.S. practice.

Applicants request reconsideration of their application without further amendment to the claims as follows.

Brief Summary of the Invention

The present invention is directed to a liquid crystal film and to a liquid crystal display device having the liquid crystal film.

The specification (pages 1-4) discloses conventional liquid crystal films for liquid crystal display devices. As described in the specification, one type of conventional liquid crystal film is produced by forming a thin film of a polymeric liquid crystalline substance over a substrate with alignability and then heating the film to a temperature equal to or higher than the glass transition temperature ("Tg") so as to align the liquid crystal molecules, followed by quenching of the film so as to fix the aligned liquid crystal molecules.

However, although the foregoing method is applicable to both main chain- and side-chain type polymeric liquid crystalline substances, it suffers from the problem that available alignment substrates are limited because the temperature at which the liquid crystallinity is exhibited rises when using a main chain-type polymeric liquid crystalline substance with a high T_g. Furthermore, when using a side chain-type polymeric liquid crystalline substance, the heat resistance of the resulting liquid crystal film is inferior and the orientation of the corresponding liquid crystals become disordered at a temperature in the vicinity of the T_g.

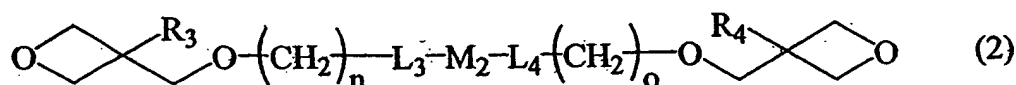
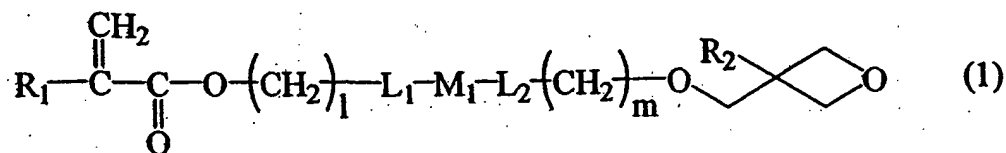
It has been proposed to resolve the foregoing and other problems with conventional liquid crystal films by providing a liquid crystal film in which a reacted group is directly introduced into a polymeric liquid crystalline substance with a relatively low T_g, such as a side chain-type one, and then cross-linked with an external stimulus such as light or heat after aligning the reactive group in a liquid crystal state, thereby raising the T_g. However, a problem with the foregoing liquid crystal film is that it has been difficult to synthesize such a side chain-type polymeric liquid crystalline substance with a reactive group. For example, when the polymeric substrate is constructed prior to the introduction of a reactive group, the amount thereof is prone to be insufficient. On the other hand, when a side chain-type polymeric liquid crystalline substance having a

reactive group is synthesized from a monomer having two reactive groups by polymerizing one of the reactive groups, it becomes necessary to maintain the reactivity of the other reactive group lower than that of the reactive group to be reacted, leading to a problem that the reaction of the reactive group after aligning the reaction group in a liquid crystal state becomes insufficient.

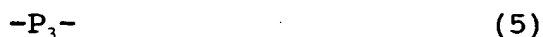
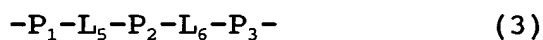
The present invention overcomes the drawbacks of the conventional art by providing a liquid crystal film having excellent heat resistance and produced by fixing an aligned structure of a liquid crystal material containing a side chain-type polymeric liquid crystalline substance obtained by polymerizing a novel compound having reactive groups with excellent reactivity for fixing the aligned liquid crystal structure and a difunctional low molecular weight liquid crystalline substance having two or more such reactive groups.

Figs. 1-10 disclose an example of a liquid crystal film (e.g., denoted by reference numerals 11 and 12 in Figs. 9-10) embodied in independent claim 1. The liquid crystal film according to the present invention is obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type polymeric liquid crystalline substance obtained by homopolymerizing the (meth)acrylic portion of a (meth)acrylic compound having an oxetanyl group represented by the following formula (1) or by copolymerizing the same with another (meth)acrylic compound and a

difunctional low molecular weight liquid crystalline substance having two oxetanyl groups represented by the following formula (2):

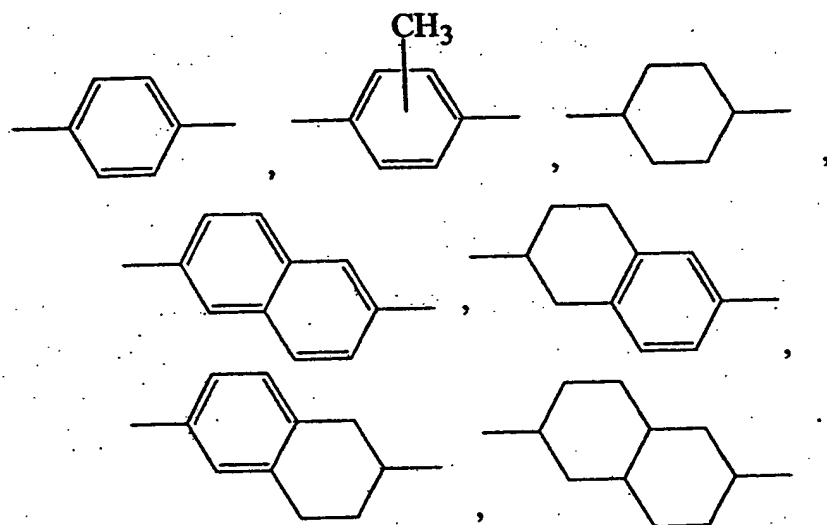


In the foregoing formulas (1) and (2), R_1 is hydrogen or methyl; R_2 , R_3 , and R_4 are each independently selected from the group consisting of hydrogen, methyl, and ethyl; L_1 , L_2 , L_3 , and L_4 are each independently selected from the group consisting of a single bond, $-\text{O}-$, $-\text{O}-\text{CO}-$, and $-\text{CO}-\text{O}-$; M_1 and M_2 are each independently represented by a formula selected from the group consisting of formulas (3), (4) and (5) below; and 1 , m , n , and o are each independently an integer from 0 to 10:

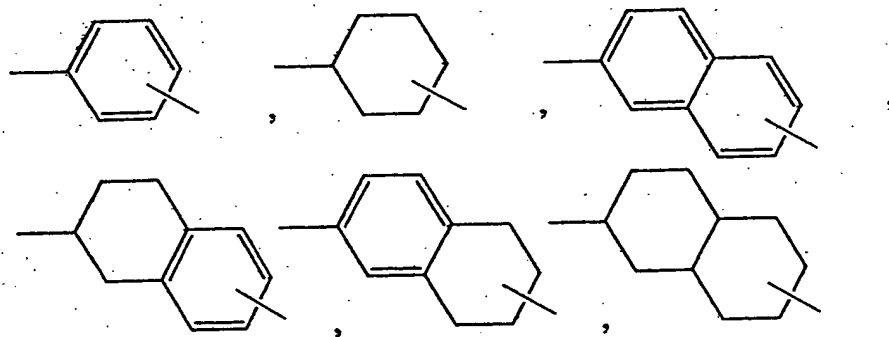


In formulas (3)-(5), P_1 and P_2 are each independently a group selected from the group consisting of formulas (6) below; P_3 is a group selected from the group consisting of formulas (7) below; and L_5 and L_6 are each independently selected from the

group consisting of a single bond, $-\text{CH}=\text{CH}-$, $-\text{C}\equiv\text{C}-$, $-\text{O}-$, $-\text{O}-\text{CO}-$ and $-\text{CO}-\text{O}-$:



(6)



(7)

By the foregoing construction, the present invention embodied in independent claim 1 provides a liquid crystal film having excellent heat resistance and reactivity. This is accomplished by fixing an aligned structure of a liquid crystal material containing a side chain-type polymeric liquid crystalline substance obtained by homo- or co-polymerizing an oxetanyl group-containing a (meth)acrylic compound with a specific chemical structure as represented by the foregoing formula (1) and a low molecular weight liquid crystalline substance having two oxetanyl groups as represented by the foregoing formula (2). No corresponding structural combination is disclosed or suggested by the prior art of record.

The Examiner rejected claims 1-10 under 35 U.S.C. §103(a) as being unpatentable over Lub. The Examiner contends that Lub teaches the specific structure of the liquid crystal film recited in independent claim 1 obtained by fixing an aligned structure of a liquid crystal material containing at least a side chain-type polymeric liquid crystalline substance obtained by homopolymerizing the (meth)acrylic portion of a (meth)acrylic compound having an oxetanyl group represented by the recited formula (1) or by copolymerizing the same with another (meth)acrylic compound and a difunctional low molecular weight liquid crystalline substance having two oxetanyl groups represented by the recited formula (2). Applicants respectfully disagree with the Examiner's contention.

Lub is directed to a photopolymerizable liquid crystalline dioxetane compound. While the compound disclosed by Lub teaches the liquid crystalline substance represented by formula (2) in claim 1, Lub does not disclose or suggest the other component of the liquid crystal film recited independent claim 1, namely, a side chain-type polymeric liquid crystalline substance obtained by homo- or co-polymerizing an oxetanyl group-containing a (meth)acrylic compound having the specific chemical structure as represented by formula (1).

The Examiner has relied upon several parts of the disclosure in columns 1, 4, 8 and 15 of Lub in support of the rejection of independent claim 1 under 35 U.S.C. §103. Applicants respectfully submit that such parts of the Lub disclosure do not disclose or suggest the structural combination of the liquid crystal film recited in independent claim 1.

With respect to the disclosure in column 4, lines 25-65, Lub discloses formula I which corresponds only to the liquid crystalline substance represented by formula (2) recited in independent claim 1.

Column 8, lines 45-50 of Lub discloses a composition comprising a compound of formula I and other compounds such as a non-reactive liquid crystal, prior art monomers or oligomers, oxetane monomers and the like. However, Lub merely describes that such other compounds are conventional ones, and Lub does not disclose or suggest any specific definition for these compounds. Particularly, Lub fails to disclose or

suggest that any of these compounds correspond or relate to the substance represented by formula (1) recited in independent claim 1.

In column 1, lines 45-55, Lub describes a conventional method for fixing a liquid crystal phase using a liquid crystal having polymerizable groups. According to this disclosure, LC molecules with polymerizable groups, such as LC acrylates, epoxides and vinyl ethers are usually employed, together with an appropriate photo-initiator. However, Lub does not disclose or suggest at all the types of polymerizable groups which are used.

In column 15, lines 25-35, Lub discloses processes for producing liquid crystal films. However, the liquid crystal films obtained by such processes are completely different from the process for obtaining the liquid crystal film recited in independent claim 1. In Lub's processes, alignment and polymerization are conducted in a cell, (i.e., a closed space between a pair of substrates) while in the present invention, alignment and polymerization are conducted in a substrate under atmospheric conditions.

Thus, Lub does not disclose or suggest the oxetanyl group-containing (meth)acrylate having the specific chemical structure as represented by formula (1) recited in independent claim 1, which represent compounds having reactive groups which are completely different in polymerizability. More specifically, the compounds represented by formula (1) recited in independent claim 1 have at one end an acryloyl group which

is a radical and anionic polymerizable group and at the other end an oxetanyl group which is a cationic polymerizable group. Lub does not disclose or suggest such compounds having groups of completely different polymerizability.

Thus one of ordinary skill in the art would not have been led to modify Lub in the manner proposed by the Examiner in the statement of rejection. The only basis for the modifications urged by the Examiner in the rejection is applicants' own disclosure, and such hindsight rejections are improper. See, for example, Diversitech Corp. v. Century Steps, Inc., 7 USPQ2d 1315, 1318 (Fed. Cir. 1988); In re Geiger, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987); Panduit Corp. v. Dennison Manufacturing Co., 227 USPQ 337, 343 (Fed. Cir. 1985); Interconnect Planning Corp. v. Feil, 227 USPQ 543, 551 (Fed. Cir. 1985).

Claims 2-10 depend on and contain all of the limitations of independent claim 1 and, therefore, distinguish from Lub at least in the same manner as independent claim 1.

In view of the foregoing, applicants respectfully request that the rejection of claims 1-10 under 35 U.S.C. §103(a) as being unpatentable over Lub be withdrawn.

In view of the foregoing amendments and discussion,
the application is believed to be in allowable form.
Accordingly, favorable reconsideration and allowance of the
claims are most respectfully requested.

Respectfully submitted,

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Name

Debra Buonincontri

Signature

November 2, 2005

Date